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Full Length Research Paper

Nasal carriage and methicillin resistance of *Staphylococcus aureus* in patients and hospital staff in a tertiary referral center setting

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The prevalence of nasal carriage of *Staphylococcus aureus* and methicillin-resistant *S. aureus* (MRSA) were studied from June 2006 – 2007 among in patients and hospital staff in a tertiary referral center setting in Ankara, Turkey. Methicillin resistance was evaluated by Kirby-Bauer disc diffusion method. Of 438 people, 106 (24.2%) were nasal carriers of *S. aureus*. The prevalence of nasal carriers for *S. aureus* were not significantly different between the hospital staff, in-patients and out-patients (p>0.05). The overall prevalence of MRSA was 23.6%. The prevalence of MRSA carrier hospital staffs and in-patients was not significantly different (p>0.05). However, the prevalence of MRSA was higher in the medical staffs and in-patients compared to out-patients (p<0.01). The prevalence of nasal carriers is higher in the hospital staff and in-patients compared to out-patients. Therefore, even a tertiary referral hospital can be the source of methicillin resistance as well as transmission of the resistance.

Key words: Nasal carrier, methicillin-resistant *Staphylococcus aureus* in patients and hospital staff.

INTRODUCTION

Staphylococcus aureus, an important human pathogen causing nosocomial and community-acquired infections, can colonize in the anterior nares and skin. *S. aureus* infections are assumed to arise from nasal carriage. The prevalence of nasal carriage varies widely between different populations. The prevalence of infection is higher in carriers than in non-carriers, and the carrier prevalence ranges from 20 to 65% in both patients and healthy population. Transmission of *S. aureus* occurs mainly through person to person contact (Kluytmans et al., 1997). Although colonization of multiple body sites occurs, the anterior nares are the most frequent carriage site. *S. aureus* nasal colonization can be an indicator of high risk for subsequent infection, as MRSA is well known to be a significant risk factor wherever *S. aureus* colonization is present (Ellis et al., 2004; Von Eiff et al., 2001). Methicillin-resistant *S. aureus* (MRSA) is a major health problem, which can cause both asymptomatic colonization and infection, ranging from minor skin infections to life- threatening conditions (Voss and Doebbeling, 1995). MRSA has been one of the causative agents of community-acquired and nosocomial infections, which are difficult to treat (Lu et al., 2005; Bachert and Robillard, 2005: Eileen and Richard, 2001). Recently, outbreaks of MRSA infection without evident inpatient healthcare related risk factors have been reported, suggesting the emergence of community-acquired MRSA. The incidence and prevalence of MRSA varies widely between countries, geographical regions, hospitals and even wards in the same hospital. MRSA may spread from person to person and from one hospital to another, causing outbreaks (Ayliffe, 1996) . The aim of this study was to determine the prevalence of nasal carriers for *S. aureus* and MRSA in patients and medical staff in a tertiary referral center setting.

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Table 1. Distribution of *S. aureus* nasal carriers isolated among hospital staff, in-patients and out-patients according to gender.

Subjects	*S. aureus* positive			*S. aureus* negative		
	Male N (%)	Female N (%)	Total N (%)	Male N (%)	Female N (%)	Total N (%)
Hospital staff (n=121)	21	1	22(18.1)	57	42	99 (81.8)
Medical doctor(n=45)	8	-	8 (17.7)	23	14	37 (82.2)
Nurse(n=26)	-	1	1(3.8)	-	25	26 (100)
Ancillary staff(n=12)	1	-	1(8.3)	9	2	11 (91.6)
Kitchen staff (n=38)	12	-	12(31.5)	25	1	26 (68.4)
In-patient (n=194)	28	22	50(25.7)	88	56	144 (74.2)
Out-patients (n=123)	10	24	34(27.6)	16	73	89 (72.3)
Total (n=438)	59 (55.7)	47(44.3)	106 (24.2)	161(48.5)	171 (51.5)	332 (75.8)

MATERIALS AND METHODS

Study population

The study was conducted in a university hospital (1400 beds, 1048 doctors, 24000 out-patients and 4000 in-patients were admitted to the otolaryngology clinic every year). Between June 2006 and June 2007, as a report of accepted practice at that time, nasal swabs were obtained from hospital staffs, out-patients and in-patients (totally 438 participants) in a tertiary referral center setting. An informed consent was obtained from the participants. Hospital staff comprised medical doctors, nurses, ancillary staff and kitchen staff. For in-patients, those with active nasal infection and remained hospitalized less than 4 days were not included in the study. For out patients, absence of an active nasal infection was the inclusion criteria.

Bacterial investigations

Samples were collected by repeatedly swabbing circularly both anterior nares with sterile cotton-tipped moistened swabs and placing the swabs into tubes of transport media or sterile normal saline (Transwab, Medical Wire and Equipment Co. Ltd.) and kept at 4°C. The mean age was 48.3 (range ≤10 - ≥60) years. The swabs were inoculated and streaked on to mannitol salt agar (MSA-Oxoid) and blood agar plates (Oxoid, Amsterdam, The Netherlands) and incubated aerobically at 35°C for up to 72 h. Mannitol-fermenting yellow or gold colonies and /or ß- haemolytic or typical colonies on blood agar was Gram stained and further screened for identification as *S. aureus* following conventional procedures. Colony morphology, catalase, slide (Staphaurex Plus; Remel; Lenexa, Kan) and tube coagulase (coagulase plasma, rabbit with ethylenediamine tetra- acetic acid; Becton Dickinson Microbiology Systems, Sparks, MD, USA) were used for identification (Murray et al., 2003). *S. aureus* ATCC 25923 and MRSA ATCC 33591 strains were used as quality control reference strains. Methicillin resistance was tested with Kirby-Bauer disk diffusion technique using a 1 µg oxacillin disk. Zone diameter on Muller Hinton Agar (Muller Hinton Agar, Difco Laboratories, Detroit, MI, USA), was measured after incubation at 35°C for 24 h. Strains with zone diameter less than 10 mm were regarded as methicillin resistant (CLSI, 2003).

Statistical analysis

SPSS 11.0 for Windows program was used for the statistical analyses, and chi-square test was used.

RESULTS

Of 438 people, 106 (24.2%) were nasal carriers of S. aureus. Of 106 *S. aureus* carriers, 59 (55.7%) were male, 47 (44.3%) were female people, with a mean age of 48.3 years There was no statistically significant difference between the hospital staff, in-patients and out-patients regarding prevalence of nasal *S. aureus* carriers ($p>0.05$). For the hospital workers, there was significant difference between nurses and kitchen staff regarding the prevalence of nasal *S. aureus* carriers ($p=0.01$) (Table 1). There was no significant difference between the genders regarding nasal *S. aureus* carriage ($p>0.05$) except for medical staff. The prevalence of *S. aureus* carrier was higher in male staff doctors compared to female staff ($p=0.01$) (Table 1). The prevalence of *S. aureus* carriers versus age distribution of the participants is shown in Figure 1. Of the 106 nasal carriers of S. aureus, 25 (23.6%) carried MRSA and 81(76.4%) carried MSSA. There was no significant difference between the hospital staff and in- patients regarding the prevalence of MRSA carriers and MSSA ($p>0.05$). However, the prevalence of MRSA was higher in the hospital staff and in-patients compared to out-patients ($p<0.01$) (Table 2).

DISCUSSION

S. aureus is a common community and nosocomial pathogen of growing concern due to multidrug-resistant clones of MRSA. Unrecognized colonization of *Staphylococcus* on the skin or mucous membranes may be significant reservoirs accounting for the spread of MRSA infections. The important reservoirs of MRSA in hospitals are infected or colonized patients, and transient hand carriage on the hands of health care workers is the predominant mode for patient-to-patient transmission

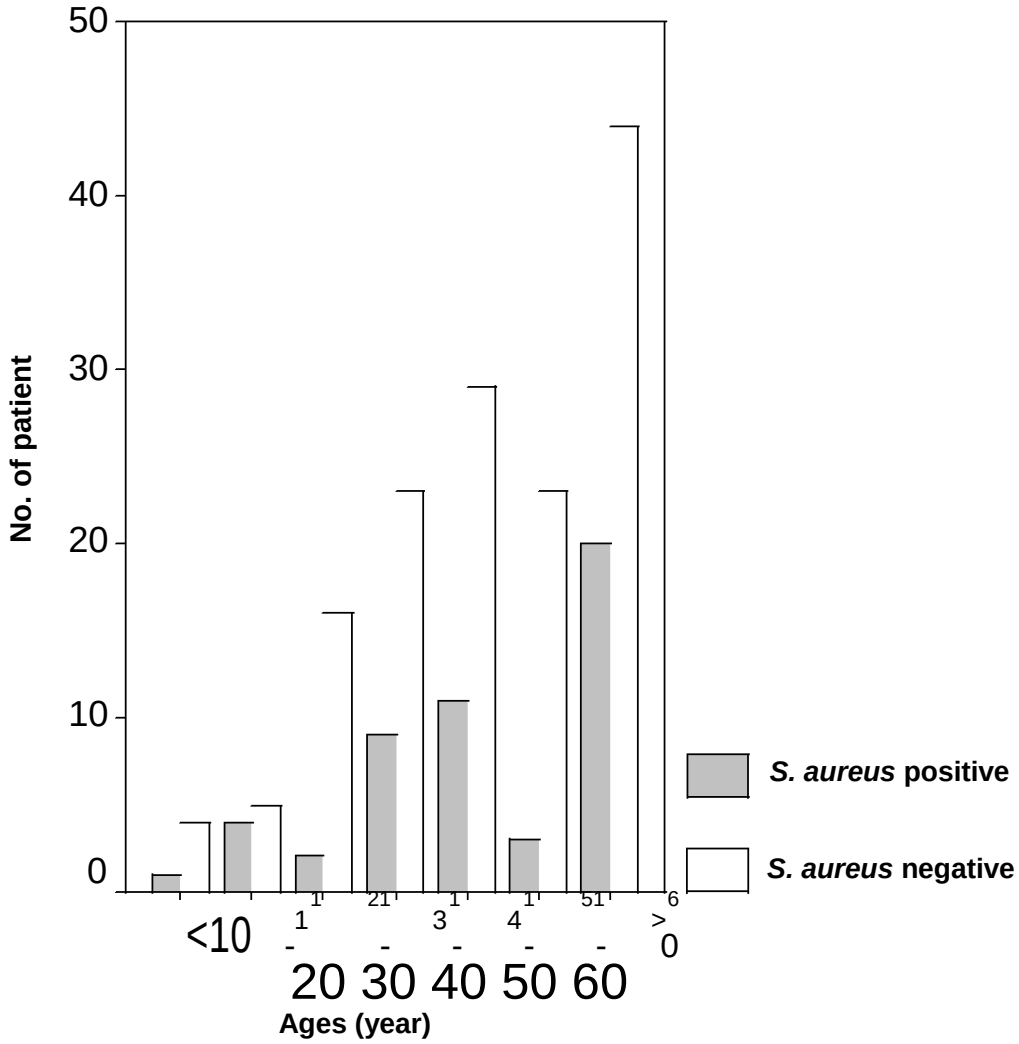

Figure 1. The prevalance and age distribution of nasal carriers of *S. aureus* among hospital staffs, in patients and out-patients.

Table 2. MRSA and methicillin sensitive *S. aureus* in the patients and hospital staff.

Subjects	MRSA No. (%)	MSSA No. (%)	Total No. (%)
Hospital staff	5 (22.7)	17 (77.3)	22 (100)
Medical doctor	3 (37.5)	5 (62.5)	8 (100)
Nurse	-	1 (100)	1 (100)
Ancillary staff	-	1 (100)	1 (100)
Kitchen staff	2 (16.7)	10 (83.3)	12 (100)
In-patient	19(38)	31 (62)	50 (100)
Out-patients	1(3)	33 (97)	34 (100)
Total	25 (23.6)	81 (76.4)	106(100)

(Thompson, 1982). In the USA, the prevalence of MRSA nasal carriage was found to be 2.6% in the patients (Troillet et al., 1998). In the same country, among employees of a nursing home, 29% were positive for *S. aureus*, and 14% had nasal carriage of MRSA (Sowirka et al., 2000). The prevalence of *S. aureus* nasal colonization among attendees of the 13th European Congress of Clinical Microbiology and Infectious Diseases was found to be 31.4%, and a statistically significant difference was found between the physicians (37.4%)

and non-physicians (21.7%) regarding the prevalence of *S. aureus* nasal carriers (Nulens et al., 2005).

In Spain, the prevalence of nosocomial infections with MRSA (31%) is two-fold higher than the prevalence of community-acquired infections with MRSA (14%). There is an increase in the prevalence of MRSA related nosocomial infections (from 22 to 41%) and community acquired infections (from 7 to 28%) within the last decade (Asensio et al., 2005). In our study, overall prevalence of nasal carriers of *S. aureus* and MRSA were 24.2 and 23.6%, respectively. In the previous study in Turkey, the prevalence of nasal carriers of *S. aureus* and MRSA were reported to be 17 to 85% and 13%, respectively (Dayan et al., 1997; Karabiber, 1991) . It seems that the prevalence of *S. aureus* carriers in our study is com-parable to the prevalence reported by Dayan et al. (1997) and (Karabiber, 1991). However, the prevalence of MRSA carriers in our study is higher than the prevalence reported by Dayan et al. (1997) and (Karabiber, 1991). In our study, nasal *S. aureus* carrier among the hospital staffs, out-patients and in-patients were similar. However, the carrier prevalence for MRSA was higher in the medical staffs and in-patients compared to out-patients. *S. aureus* and MRSA colonizing in the nares may be transferred or spread from patient to healthcare worker, patient to patient, or healthcare worker to patient. The primary route of MRSA transmission within a hospital appears to be from the medical staff to the patients (Murray et al., 2003). Nasal carriers of *S. aureus* may be encountered in all age groups. However, *S. aureus* infections cause significant morbidity and mortality in the elderly. In addition to that, previous studies showed that the prevalence of nasal carriers of MRSA and *S. aureus* is highest over 75 years of age, with higher prevalence in males than in females (Morgan et al., 1997). Although the prevalence of *S. aureus* carriers was similar in all age groups in our study, the carrier frequency was higher in males than female medical staff. In summary, in the present study, the prevalence of nasal colonization of *S. aureus* is high (24.2%). The carrier prevalence does not change with age.

In conclusion, the prevalence of MRSA is higher in the hospital staff and in-patients compared to out-patients. Hospital staff is at high risk in terms of MRSA carriage. Patients can acquire MRSA after hospitalization. Therefore, even a tertiary referral hospital can be the source of methicillin resistance as well as transmission of the resistance.

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